

3. REMOVAL ACTION TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

Consistent with the EPA guidance and NCP regarding removal actions, the development of alternatives was conducted in two steps. First, applicable media- and chemical- or radiological-specific technologies were identified and screened. Second, technologies that passed the screening process were incorporated singularly or in combination with other options to develop alternatives for detailed evaluation.

Because the site is impacted by both radioactive and chemical constituents, the number of practical and suitable treatment technologies that can be applied is limited. The technologies considered during the development of the removal action alternatives include those identified in the NCP. Additionally, presumptive technologies (those that are based on experience and information gained from removal action planning and implementation at FUSRAP and other radioactively and chemically impacted sites) are incorporated. These technologies were examined and incorporated based on their applicability to the Colonie site.

3.1 TECHNOLOGY IDENTIFICATION AND SCREENING

Removal technologies and process options were selected on the basis of their applicability to the impacted environmental media at the Colonie site. The impacted media of interest at the Colonie site are soil and groundwater. For the purpose of this EE/CA, soil is defined to include soil, sediment, asphalt, and rubble. As discussed in Section 2, the chemical COCs for soil are lead and copper. The radioactive COCs for soil are U-238 and Th-232. In addition, pyrophoric waste (i.e., waste which has the potential to spontaneously ignite and burn) has been reported under the loading dock east of Bay 2. The COCs for groundwater include PCE, TCE, 1,2-DCE, lead, zinc, and total uranium.

Technologies that would not be effective in a reasonable amount of time, that are not applicable to the COCs, or that were determined to be unreliable were eliminated from further consideration.

Sections 3.1.1 through 3.1.6, though not all-inclusive, provide an overview of relevant source and migration control technologies that could be applied to protect human health and the environment. These technologies have been screened on the basis of site-specific conditions and the current understanding of the nature and extent of chemicals and radioactivity at the Colonie site.

The four impacted media identified at the Colonie site include: radioactively impacted surface soils; radioactively impacted subsurface soil, including potentially pyrophoric wastes below the loading dock; chemically impacted surface and subsurface soil; and the potentially impacted asphalt from the parking lot.

The amount of impacted surface and subsurface soil to be remediated would be approximately 20,000 m³ (26,200 yd³) if only radiological material is remediated or 35,900 m³ (46,900 yd³) if heavy metals are included as well (BNI 1993b). This includes 1,300 m³ (1700 yd³) of asphalt which could potentially meet volumetric release criteria after it is excavated. During site cleanup, the actual surface and subsurface volume to be remediated at the site will be determined from screening analysis. Soil material and groundwater that exceeds ARARs (Table 2-3 and Appendix B) will be addressed in accordance with the removal action alternative selected.

A discussion of potentially applicable primary response actions that would meet the removal action objectives for the Colonie site follows. Response actions that do not meet removal action objectives but are dictated as pre- or post-treatment requirements are not discussed below, but are discussed in Section 6 as secondary requirements associated with disposal.

3.1.1 No Action

The no-action alternative is considered in accordance with CERCLA regulations and National Environmental Policy Act (NEPA) values, and provides a baseline for comparison with other alternatives. Under the no-action alternative, no further action or maintenance of existing institutional controls (e.g. fencing) is assumed. The no-action alternative does include monitoring. All affected media would be monitored for a minimum of 30 years to track potential migration of the chemicals and radioactivity.

3.1.2 Institutional Controls

Institutional controls are a limited-action technology because they can reduce the potential for exposure to chemical and radioactive materials, but they do not reduce the toxicity, mobility, or volume of the materials. Institutional controls can include such measures as site security (fencing and guards), deed restrictions, providing an alternative water supply, monitoring, 5-year reviews to determine continued effectiveness of the controls, and relocating nearby receptors.

The Colonie site is already fenced, with access limited by an electronically controlled gate. Water use restrictions may be necessary because the groundwater is currently classified as a potential source of drinking water; however, no groundwater supply wells exist on the site, or within 1 mi. of the site, at this time. No alternate water supply is required because the city's drinking water supply is unaffected by potential constituent migration offsite in groundwater. Deed restrictions may be appropriate depending on the final remedy selected for the site. Monitoring is currently being conducted and is likely to continue for a time after implementation of a final remedy to demonstrate the effectiveness of the remedy. Because institutional controls such as access restrictions are not particularly effective or reliable in the long term, it is unlikely these would be selected as a stand-alone alternative. Additionally, the NCP provides that, "the use of (institutional controls) shall not substitute for active response measures . . . as the sole remedy unless such active measures are determined not to be

practicable, based on the balancing of trade-offs among alternatives that is conducted during the selection of remedy" (40 CFR §300.430(a)(1)(iii)(D)).

3.1.3 Containment

Containment is a response action in which the source chemical and radioactive materials are enclosed in place and isolated from potential receptors. Migration of materials is controlled by continued maintenance of the containment structure. Containment technologies include surface barriers such as capping, and subsurface barriers such as slurry walls.

3.1.3.1 Surface Barriers

Capping is a specific response action that would isolate the impacted soils from contact with the public and greatly reduce gamma radiation exposures. Capping consists of sealing or covering an area with a layer of materials of low permeability. Isolation would also reduce migration of materials due to rainfall, percolation, stormwater runoff, and wind. However, horizontal migration of chemicals and radioactivity in groundwater could still occur. If the impacted soils were capped in place, the site could require an ongoing maintenance program because the toxicity and quantity of the materials would not be altered by capping. The useful life of the cap would depend on the capping material used, exposure of the cap to the elements, and the constituents in the soil.

Multimedia caps function by diverting infiltrating water from the vegetative layer through the drainage layer and away from the underlying waste materials. The low permeability layer of the multimedia cap can be composed of natural soils, admixed soils, a synthetic liner, or any combination of these materials.

Caps commonly used in construction are made of clay, asphalt, concrete, synthetic materials, or a combination of these (multimedia). Therefore, caps could be constructed quickly using readily available materials. The equipment used for implementing this technology is standard construction equipment. An earthen cap would reduce gamma radiation exposures to acceptable levels and prevent direct human contact with COCs.

3.1.3.2 Subsurface Barriers

Subsurface barriers, such as vertical slurry walls and sheet piles, are installed around a zone to confine material and groundwater containing the COCs. Though relatively simple to install, the use of barriers would depend on the process selected, the geology of the site, and the physical and chemical characteristics of the soil at the site and the COCs. These barriers could serve as the container wall to prevent exposure and migration when used in conjunction with capping. However, based on the site characterization data, it does not appear that the constituents are migrating offsite; thus, eliminating the need for subsurface barriers.

3.1.4 Removal

3.1.4.1 Soil

Excavation techniques are (1) reliable, (2) could be implemented with standard construction procedures and conventional equipment, and (3) have been used extensively to control radioactivity and chemicals similar to that associated with the Colonie site. Because of the high water table onsite, dewatering would be required for a portion of the excavated soil.

3.1.4.2 Groundwater

Conventional removal of impacted groundwater by pumping is feasible for sites where underlying aquifers have high hydraulic conductivity (EPA 1985). However, at sites having separate phase organics in the aquifer, pumping has been unsuccessful in permanent aquifer restoration. The separate phase liquids continue to diffuse into the groundwater and will continue to impact the aquifer if pumping is discontinued. The upper hydraulic units beneath the Colonie site consist of upper and lower sandy silt units separated by a discontinuous clay unit. Pumping could be combined with containment to avoid movement of VOCs through the aquifer. Pumping could be continued after excavation of the sources to provide long-term control and extraction of impacted groundwater. The effectiveness of pumping can sometimes be enhanced by injecting surfactant into the aquifer upgradient of the extraction wells.

3.1.5 Treatment

3.1.5.1 Soil

In general, treatment is performed for one of the following reasons: (1) to meet removal action objectives, (2) to comply with the waste acceptance criteria of a disposal facility, or (3) to reduce toxicity, mobility or volume. Section 121(b) of CERCLA states a preference for treatment over conventional containment or land disposal approaches to address the principal threat at a site, where practical. Even if the hazardous characteristic components of the waste were stabilized or removed by treatment, the waste would still potentially require disposal because of the radioactive constituents. However, treatment technologies will be considered which could potentially reduce the volume of waste to be shipped offsite or reduce the mobility of the COCs or otherwise reduce the cost of remediation. These technologies include soil washing and in-situ solidification.

Soil washing involves the leaching of waste constituents from soil for recovery and treatment. It can reduce the volume of soil that must be disposed by removing the COCs from the soil so that the soil can be replaced after treatment. Washing solutions may include water, acidic or basic aqueous solutions, or aqueous solutions containing chelating agents, reducing or oxidizing agents, or surfactant. Solvents may also be used, but must be recovered completely from the treated soil. Soil is physically excavated from the site, mixed with the washing solution, then separated from the washing solution. The treated soil may be used as backfill at

the site. The spent washing solution may be treated and recycled back to the washing system or treated and discharged to Patroon Creek or to a publicly owned treatment works.

The majority of soil washing techniques involve partitioning the COCs to the fine fraction of the soil through washing or attrition scrubbing followed by separation into two soil fractions according to particle size. The fine fraction is usually comprised of fine silt and clay and typically constitutes less than 20 per cent of the total soil by weight. Partitioning of COCs to the washing solution depends on the solubility of the COCs in the solution and the ability of the solids separation process to remove very fine suspended solids from the solution.

Soil washing is a well developed technology. Its effectiveness, however, can vary greatly depending on the specific constituent(s) involved and the site-specific properties of the soil. Consequently, treatability studies are necessary to assess the potential effectiveness of this technology at this site.

In-situ solidification, or deep soil mixing, is an in-situ stabilization process capable of stabilizing soil and improving soil properties. The process mixes the impacted soil with a slurry forming a cement-like matrix that immobilizes the soil constituents, increases soil strength, decreases soil permeability, and provides many other geotechnical improvements without having to excavate.

Deep soil mixing uses standard construction equipment with some specialized attachments. Crane supported leads guide a special attachment consisting of hollow stemmed augers and mixing paddles, which can penetrate soil to depths of more than 100 ft. During penetration, a slurry containing cement-based or pozzolan-based stabilizing agents is injected into the soil through the hollow stemmed augers. The mixing paddles blend the soil and slurry to form a cement matrix. The slurry continues to be injected as the auger is withdrawn to ensure that the slurry and soil are thoroughly mixed.

3.1.5.2 Groundwater Treatment

Physical

Technologies considered for treatment of groundwater included precipitation/flocculation, air stripping, activated carbon adsorption, and ion exchange.

Precipitation/flocculation is a proven technology for removing solids. To separate the desired constituents from water, small particulates are aggregated into larger particles that settle more readily. Precipitation/flocculation is a technique used in hazardous waste treatment to remove a large proportion of the metal constituents. Generally, lime or sodium sulfide is added to the waste water in a rapid mixing tank with flocculating agents such as alum, ferric chloride, or ferrous sulfate causing particle precipitates to form. The waste stream then flows to a flocculating (slow mix) vessel in which adequate mixing and retention time is provided for aggregation of these precipitate particles. The aggregated particles, or flocs, are separated from

water by settling in a sedimentation vessel and/or by filtration. In essence, precipitation/flocculation involves the following four basic steps:

- addition of chemicals such as lime or sodium sulfide with chemical flocculating agents,
- rapid mixing to disperse the chemicals,
- slow and gentle mixing to allow contact between small precipitate particles and promote their aggregation into larger particles, and
- settling of aggregates in a sedimentation vessel and/or filtration.

Air stripping is an effective technology for removing volatile organic constituents such as TCE and PCE from groundwater. Groundwater enters the top of the column where it is dispersed with spray jets or other diffusers. Blowers force air into the bottom of the column. Air stripping works by partitioning the volatile organics from the water to the air phase.

Several types of packing material are employed in air strippers to increase their efficiency. In the packed system, the influent water flows over the packing materials to expose an increased surface area to the counter-current air stream; thus, enhancing mass transfer between air and water. The degree of separation achieved is contingent upon physical and chemical properties and various design parameters for the air stripper. The efficiency of air strippers in removing VOCs depends on each compound's Henry's Law constant, which is an equilibrium distribution coefficient of the concentrations of the individual compounds between the air and liquid phases. A higher value of Henry's Law constant indicates a higher affinity of that organic compound for the air phase and therefore more efficient removal from groundwater. Based on their Henry's Law constants, TCE, PCE, and 1,2-DCE are readily strippable. A vapor phase filter system (e.g., granular activated carbon filters) could be installed to remove the VOCs from the effluent air stream.

Activated carbon is a well-developed technology that is widely used for removal of mixed organics from aqueous wastes. In addition, some metals and inorganic species have shown adsorption potential. The process of adsorption onto activated carbon involves contacting a waste stream with the carbon, usually by flow through a series of packed-bed reactors. The activated carbon selectively adsorbs hazardous constituents by a surface attraction phenomenon in which organic molecules are attracted to the adsorption surfaces of the carbon granules.

Adsorption efficiency depends on the strength of the molecular attraction between adsorbent and adsorbate, molecular weight, type and characteristic of adsorbent, electrokinetic charge, pH, and surface area. Once the micropore surfaces are saturated with organics, the carbon is spent and must either be replaced with new carbon or removed, thermally regenerated, and replaced. The time to reach breakthrough or exhaustion is the critical operating parameter. Carbon longevity balanced against influent concentration governs operating economics.

Most hazardous waste treatment applications involve the use of adsorption units that contain granular activated carbon and operate in a downflow fixed-bed series mode. The downflow fixed-bed series mode has been found to be cost-effective and produces lower effluent concentrations relative to other carbon adsorber configurations (e.g., downflow in parallel, moving bed, upflow-expanded). The units may be connected in parallel to provide increased hydraulic capacity.

Ion exchange is a process whereby toxic ions are removed from the aqueous phase by being exchanged with relatively harmless ions held by the ion exchange material. Modern ion exchange resins are usually synthetic organic materials containing ionic functional groups to which exchangeable ions are attached. These synthetic resins are structurally stable (i.e., can tolerate a range of temperature and pH conditions), exhibit a high exchange capacity, and can be tailored to show selectivity toward specific ions. Exchangers with negatively charged sites are cation exchangers because they take up positively charged ions. Anion exchangers have positively charged sites and, consequently, take up negative ions. The exchange reaction is reversible and concentration dependent, and it is possible to regenerate the exchange resins for reuse. Sorptive (macroporous) resins are also available for removal of organics. The removal mechanism for sorptive resins is one of sorption rather than ion exchange.

Ion exchange is used to remove a broad range of ionic species from water including metals present as soluble species, either anionic or cationic. Sorptive resins can remove a wide range of polar and nonpolar organics, including PCE, TCE, and 1,2-DCE.

A practical upper concentration limit for ion exchange is about 2,500 to 4,000 mg/L. A higher concentration results in rapid exhaustion of the resin and inordinately high regeneration costs. Suspended solids in the feed stream should be less than 50 mg/L to prevent plugging the resin bed, and waste streams must be free of oxidants.

3.1.6 Disposal/Effluent Discharge

Soil

Disposal involves the placement of materials in an engineered disposal facility, which reduces the material's mobility and protects human health and the environment. Disposal options include (1) new onsite; (2) existing DOE; (3) commercial disposal facilities; or (4) beneficial reuse. New onsite facilities are not feasible because a 100 m buffer zone is required for onsite storage (BNI 1995b).

The wastes at the Colonie site contain commingled radiologically and chemically impacted soils, including mixed wastes. Radioactive wastes could be disposed at a site such as the Hanford Site; however, radioactive mixed wastes must meet the waste acceptance criteria for disposal at a licensed disposal facility. A more detailed analysis of the remaining disposal options follows:

Existing DOE Disposal Facilities. The Hanford disposal site accepts waste from offsite generators for disposal. Some other DOE sites provide disposal facilities for wastes generated onsite, but do not accept waste generated offsite.

The Hanford site has extensive waste certification requirements, including administrative requirements on receiving approval through the appropriate DOE offices for disposal of offsite waste on the Hanford Reservation. Waste accepted for disposal must be containerized.

Chemical wastes generated at the Colonie site that are regulated under RCRA cannot currently be disposed at the Hanford facility. Hence, Hanford is not a suitable site for disposal of mixed wastes from the Colonie site. However, wastes that are radioactive and not mixed with RCRA hazardous wastes meet the acceptance criteria for disposal at Hanford.

The Nevada Test Site radioactive waste disposal operation has been designated for wastes generated through DOE Defense Program operations. Because Colonie wastes were not generated from DOE Defense Programs, the Nevada disposal option is eliminated.

Commercial Disposal Facilities. Chapter III of DOE Order 5820.2 specifies that low-level radioactive waste generated through DOE operations must be disposed at a DOE facility. However, DOE has approval to use commercial disposal facilities for the disposal of DOE radioactive waste (DOE 1993b, DOE 1993c). Therefore, commercial low-level radioactive waste disposal facilities may be used for the wastes under DOE Order 5820.2A.

Three licensed low-level radioactive waste disposal facilities currently operating in the U. S. were evaluated for applicability to the Colonie wastes. One is operated by U.S. Ecology in Richland, Washington. The other two facilities include one in Barnwell, South Carolina, operated by Chem-Nuclear Systems, Inc., and one near Clive, Utah, operated by Envirocare of Utah, Inc. All three sites are licensed by their respective state regulatory agencies for receipt and disposal of low-level radioactive waste. DOE has approved the use of a commercial disposal facility for FUSRAP waste (DOE 1993b, DOE 1993c). Of the facilities evaluated, only the Envirocare facility can accept radiological wastes mixed with RCRA hazardous waste. For wastes that are solely radioactive, there are existing restrictions associated with the two other sites that limit their availability for disposal of the high-volume, low-radioactivity waste that will be generated during remediation of the Colonie site.

Limitations are being imposed by the State of Washington and by the Northwest Compact on the maximum annual volume of waste that may be disposed at the Richland facility. Allocation of the available waste volume among the current site customers may limit the availability of disposal space for Colonie wastes. In addition, the Low-Level Radioactive Waste Policy Amendments Act of 1985, under which the Northwest Compact was formed, specifies restrictions on routine acceptance of radioactive waste generated outside the Compact region. Therefore, the Colonie low-level radioactive wastes may not qualify for disposal at this facility. The Barnwell facility is not permitted to accept materials classified as 11e(2) (byproduct material).

The Envirocare facility was specifically designed for disposal of low-radioactivity, high-volume remediation wastes and was authorized for disposal of either bulk or containerized naturally occurring radioactive material, including uranium, radium, and thorium. The radioactive material license issued by the State of Utah limits the specific activity of the waste to 110,000 pCi/g for depleted uranium, 2,000 pCi/g for Ra-226, and 680 pCi/g for Th-232. The license also restricts the radionuclide concentration in waste packages by the sum-of-fractions rule. That is, the sum of the ratios of each radionuclide's concentration in the waste to its respective concentration limit must be equal to or less than one.

Of the operating offsite commercial radioactive waste disposal facilities, only the Envirocare facility is authorized to accept wastes that are also hazardous as defined by RCRA. In addition, the facility has adequate capacity for the waste volume from the Colonie Site. Therefore, the Envirocare facility would be the proposed commercial disposal option because of the low-level radioactive and the potential hazardous wastes that exist at the Colonie site. If other commercial facilities become available at the time of the removal action to be taken at the site, they would be considered as disposal options.

Groundwater

The option for disposal of groundwater and surface water runoff from the site involves effluent discharge to Patroon Creek.

3.1.7 Summary of Technologies

The representative technologies for the removal action at the Colonie site are summarized in Table 3-1.

3.2 DEVELOPMENT OF ALTERNATIVES

In this section, the representative removal action technologies that passed screening in Section 3.1 are combined into alternatives. Waste management options are developed based on the general response actions identified to meet removal action objectives. The process for developing alternatives is shown in Figure 3-1. The alternatives were developed in accordance with the NCP and EPA guidance. Preliminary removal action alternatives resulting from grouping of applicable soil technologies are listed and briefly described below.

- No action (Alternative 1)
- Excavation (Alternative 2)
- Containment and institutional controls (Alternative 3)
- Partial excavation and in-situ solidification (Alternative 4)

Groundwater is limited to onsite wells. Only one offsite well, B39W10M in the lower sand, has exceeded New York standards in the 1992 and 1993 data. The principle constituent was lead, and the average concentration was less than the average concentration for lead in any of the three lower sand background wells (Figure 1-29). Iron, manganese and sodium have also been detected above New York water quality standards in this well at concentrations within the range of the lower sands background wells. Because COCs related to site activities are not found in offsite wells above background concentrations, no groundwater treatment is planned for any of the alternatives except as necessary to treat water extracted to implement the alternatives for soil remediation.

The following elements are common to all, but the no action alternative. Upon completion of the building removal action, the building rubble will have been crushed, characterized, and, if clean, left in piles on the building slab. All alternatives will begin by tearing up and crushing the asphalt parking lot. If the crushed asphalt is determined to meet volumetric release criteria, it will be left temporarily in piles on the parking lot location. If it is found to be above release criteria, it will be shipped for offsite disposal for Alternatives 2 and 4, or consolidated in the waste burial area for Alternative 3. At this point, the soil formerly covered by the asphalt will be certified as clean so that the former parking lot can be used as a staging area for clean material. The crushed clean building rubble will then be moved to the staging area. The loading dock will be demolished next and either moved to the staging area or shipped offsite depending on if it is found to be above release criteria. The soil beneath the loading dock, which potentially may contain pyrophoric uranium, can then be excavated and sent to a long-term storage facility if uranium is present above cleanup criteria. Following excavation of the material under the loading dock, the building slab will be demolished, crushed, characterized, and moved to the staging area if it is not impacted. At this point, the soil under the slab will be verified to be clean, and the area formerly occupied by the building will be added to the staging area. The piles of crushed asphalt and rubble will be used as clean fill in Alternatives 2 and 4 or to provide a drainage layer for the cap if Alternative 3 is selected.

Alternatives 1 and 3 include institutional controls (i.e., use restrictions), continued environmental monitoring, and a 5-year review for groundwater.

A description of the alternatives follows.

3.2.1 No Action (Alternative 1)

The no action alternative is considered in accordance with CERCLA regulations and NEPA values and provides a baseline for comparison with the other three alternatives. Under this alternative, no further action would be taken to implement removal activities and reduce the hazard to potential human or ecological receptors. Therefore, existing human health and environmental risks of exposure to existing chemical and radiological material would not be reduced. In fact, under this alternative, existing controls such as fences would not be maintained; therefore, existing risks would be expected to increase over time.

3.2.2 Excavation and Disposal (Alternative 2)

3.2.2.1 Excavation

Two levels of response are considered under excavation. Alternative 2A targets excavating radiologically impacted soil, and Alternative 2B would excavate both radiologically and chemically impacted soil.

3.2.2.1.1 Large-Scale Excavation of Radiological Materials (Alternative 2A)

Excavation would involve using conventional construction equipment to remove all wastes (e.g., buried drums, scrap metal, and soil) that exceed radiological criteria of 35 pCi/g for U-238 or 5 pCi/g for Th-232 or Ra-226 in the top 15 cm (6 in.) of soil or 15 pCi/g for deeper soil intervals (Figures 1-19 and 1-20), regardless of accessibility. The building slab would also be demolished under this alternative. The total volume to be remediated is estimated to be 20,000 m³ (26,200 yd³). If buried drums are found during removal actions, they would be repackaged for direct disposal at an appropriate facility. Since soil concentrations exceed ARARs beneath the water table, a portion of the aquifer will need to be dewatered before excavation. This will require extraction and treatment of approximately three million gallons of groundwater in order to excavate to the deepest areas (5.5 to 8.5 m [18 to 28 ft]). If it is determined to be more cost-effective, wet excavation followed by ex-situ dewatering would be implemented. The unnamed tributary which flows through the burial area would have to be diverted around the site during excavation activities.

The area under the loading dock east of Bay 2 should be excavated with great caution due to the potential presence of pyrophoric uranium. Efforts will be made to determine whether or not pyrophoric uranium is present under the loading dock prior to beginning the excavation. The spontaneous ignition temperature of uranium metal particles varies depending on the size and geometry of the particles. For spherical particles, Argonne National Laboratory has determined that the ignition temperature for a 1/16 inch diameter particle is approximately 33°C. For a 1/4 inch diameter particle, the ignition temperature goes up to approximately 375°C. Combustion usually resembles smoldering producing a heavy smoke that tends to settle in the immediate vicinity. Uranium fires are easily extinguished by excluding air from the fire. At excavations in uranium burial grounds, such fires are usually handled by covering the uranium with dirt unless local conditions are favorable to producing a plume that might escape the excavation. Since the Colonie site is surrounded by an urban area, special measures will be taken to ensure a plume does not escape from the site. Fire extinguishers approved for metal fires will be readily available. Water will not control a uranium fire since uranium metal can react with water. Personnel will be equipped with respirators and protective clothing and trained to control a uranium fire.

This alternative would be protective of human health and the environment because all radiological material at the site that exceeds criteria would be removed and the site could potentially be released for industrial use. Actions under this alternative would eliminate the

potential for migration of radioactivity to surface waters or into groundwater after site cleanup. Therefore, current and future industrial use health risks would be reduced to acceptable levels. Surface water runoff associated with excavation and dewatering would be treated at the onsite treatment facility and RCRA hazardous soils would also be treated onsite to meet applicable Land Disposal Restrictions (LDR) treatment standards.

3.2.2.1.2 Large-Scale Excavation of Radiological and Hazardous Metal Materials (Alternative 2B)

This alternative would be carried out in the same manner as Alternative 2A except that metals would also be targeted for removal in addition to the radiological materials. Soil exceeding 500 mg/kg for lead, 10,000 mg/kg for copper, 1,000 mg/kg for cadmium or 180 mg/kg for thallium would also be excavated. This would increase the volume of soil excavated to 35,900 m³ (46,900 yd³). Approximately twenty-eight million gallons of groundwater would need to be extracted and treated to dewater the aquifer. Following implementation, the site could potentially be released for industrial or residential use, with water use restrictions imposed as necessary for the site's groundwater.

3.2.2.2 Transportation

The excavated soil would be transported by rail to the disposal facility. Loading material into rail cars would involve construction of loading facilities. Excavation equipment used at the site, or dump trucks, could be used to load the rail cars (assuming the existing rail spur could be repaired/modified and used for transportation of the waste offsite for disposal).

Radioactively or chemically impacted solid waste generated during removal actions would be collected and placed in containers acceptable for transportation or combined with bulk soils for shipment offsite and would meet the waste acceptance criteria of the permanent disposal facility. The rail cars used to haul materials would be inspected for safety before use. The exterior of containers would be checked and decontaminated, if necessary, before being loaded onto the rail cars. Containers would be manifested according to the applicable requirements for shipments of radioactive and chemically hazardous waste materials. Pre-designated routes would be traveled and an emergency response program would be developed for responding to accidents. The transportation of radioactive and chemical materials would strictly comply with applicable state and federal regulations.

A railroad spur on CISS provides access to the Conrail line that runs adjacent to the site. A typical gondola rail car holds 53 m³ (70 yd³) of unpacked bulk, although 46 m³ (60 yd³) is a more realistic estimate due to weight limitations. A likely maximum of 10 to 12 carloads could be loaded at a time to avoid detention fees that could be imposed by Conrail if cars are not loaded expeditiously. Approximately one shipment could be made each week. The Envirocare facility has rail access. Rail transport to the Envirocare facility would involve approximately 3,540 km (2,200 mi); the route would be by Conrail to St. Elmo, Illinois, and by Union Pacific to Clive, Utah.

Offsite disposal of radioactive wastes often raises institutional issues in jurisdictions through which the waste would be transported. Such issues arise due to a lack of public confidence that radioactive shipments will comply with safety requirements. Although radioactive materials transportation is extensively covered by federal regulations (49 CFR), state and local requirements pertaining to safety inspection, enforcement, and emergency response programs are inconsistent and vary greatly. They may vary with federal and state requirements. States exercise less control over the railroads than over motor carriers and generally do not impose special restrictions as long as manifest rules and hazardous material transport regulations are followed (Schmid 1992).

3.2.2.3 Backfilling and Seeding

Following confirmation results, excavated areas would be backfilled. Clean rubble from the demolished building and additional fill material will be used as needed to restore the site as nearly as possible to its original topography, graded to allow proper drainage, and seeded to provide an erosion control covering. Granular soil and rubble from the demolished building and slab would be used to backfill excavated areas.

3.2.2.4 Disposal

Excavated soil would be shipped by rail to an existing commercial disposal facility. Several privately-owned commercial facilities are available that could provide disposal capacity for low-level waste. The Envirocare facility accepts low-level radioactive wastes, hazardous wastes, and mixed radioactive and RCRA hazardous wastes and is therefore selected as the representative commercial disposal facility for purposes of this evaluation.

3.2.3 Containment and Institutional Controls (Alternative 3)

Similar to Alternative 2, Alternative 3 considers two levels of response for containment. Alternative 3A would simply cap or cover all COCs in place. The other alternative, 3B, is a combination of cap and cover and moderate excavation.

3.2.3.1 Cap and Cover (Alternative 3A)

This alternative involves installation of a low permeability cap over all soil that exceeds the criteria of 35 pCi/g for U-238 or 5 pCi/g for Th-232 or Ra-226. The uranium impacted soil under the loading dock would be excavated, stabilized and sent to a licensed disposal facility. The volume of this soil has been estimated to be 1,300 m³ (1,700 yd³). The building slab would be demolished and the clean rubble from the building and slab would be incorporated into the capping materials. In addition to the engineered cap over the radiologic materials, six inches of clean soil would be placed over the entire site to reduce the potential for exposure to metals. Buried drums would be detected by geophysical testing and targeted for removal prior to capping.

The design of the cap could consist at a minimum of a low permeability clay layer covered over with an upper soil layer with vegetation. The building rubble that meets release criteria could be used for a drainage layer between the clay and topsoil in this alternative. Capping will not affect the toxicity or volume of the COCs, but it could potentially reduce the mobility of some constituents. It will also provide protection of human health and the environment by reducing the potential for exposure to the COCs from direct contact with soil. Gamma radiation and radon associated with radioactive daughters of the primary radionuclides at the site would be attenuated as a result of capping. Additionally, capping would promote drainage and minimize erosion.

The existing drainage culvert entering the site on the northern perimeter of the site would be rerouted around the capped area. After the culvert is rerouted, the old culvert would be plugged and abandoned in place.

Institutional controls are an important component of this alternative and would include the continuation of government ownership of the site, access restrictions and environmental monitoring, in addition to deed restrictions, and a five-year review to evaluate protectiveness.

3.2.3.2 Moderate Excavation, Offsite Disposal of Radioactive Soil, and Cap and Cover (Alternative 3B)

In this alternative, soil exceeding 100 pCi/g for U-238 and 15 pCi/g for Th-232 or Ra-226 would be excavated and shipped to a licensed disposal facility. Drums buried deeper than the depth exceeding the 100 and 15 pCi/g criteria would not be discovered during excavation for this alternative, but these drums could be detected by geophysical testing and targeted for removal. Soil exceeding the 35 pCi/g criterion for U-238 would be consolidated in the burial area. The remaining impacted areas and consolidated soil would be capped as in Alternative 3A.

Institutional controls for this alternative are the same as for Alternative 3A, however, a much smaller area would be left impacted and a large portion of the site could potentially be released for industrial development with appropriate deed restrictions. The capped area may need continued access restrictions and maintenance. It may be necessary to purchase at least a portion of the Town of Colonie property to provide the proper slope and buffer zone for the cap.

3.2.4 Large-Scale Excavation, In-Situ Solidification (Alternative 4)

Two levels of response are considered under this alternative. In the first, Alternative 4A, only radiological material is considered for remediation. Alternative 4B targets both radiological and heavy metal constituents present at the site.

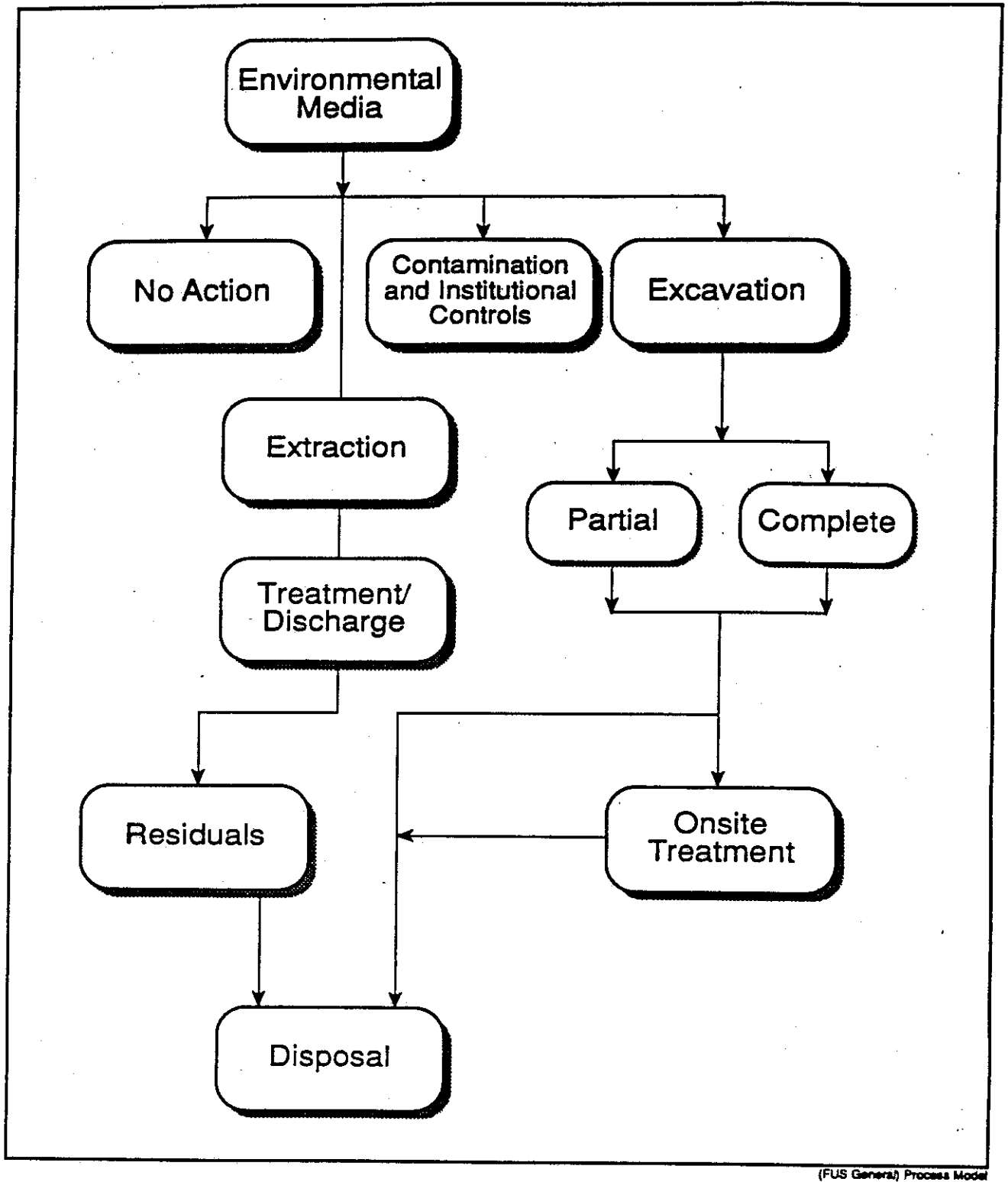
3.2.4.1 Radiological Materials Only (Alternative 4A)

In this alternative, all soils exceeding the radiological criteria of 35 pCi/g for U-238 or 5 pCi/g for Th-232 or Ra-226 in the top 15 cm (6 in) or 15 pCi/g for soil deeper than 15 cm would be excavated down to the top of the water table, approximately 2 to 9 ft. This activity would be planned during a normally dry time of the year in order to maximize the depth to the water table. The remaining impacted soil, as identified in Figure 1-20, would be stabilized and solidified in-situ to the full depth of the COCs by deep soil mixing. The volume of excavated soil is estimated to be 14,870 m³ (19,450 yd³). The volume of soil below the water table to be solidified is estimated to be 4,080 m³ (5,330 yd³). Drums buried deeper than the depth exceeding the 35 and 15 pCi/g criteria would not be discovered during excavation for this alternative, but these drums could be detected by geophysical testing and targeted for removal. As with Alternative 2, the potential for human contact with impacted soil would be greatly reduced by the implementation of this alternative. In addition, the potential for COCs leaching into the groundwater would be reduced because of the reduced permeability of the solidified mass and the incorporation of the COCs into the cement matrix. Transportation, backfilling, and disposal considerations for this alternative are the same as for Alternative 2. The building rubble, demolished slab, and asphalt will be used as backfill for this alternative if they are demonstrated to be below the criteria. Clean fill will be brought in from offsite to cover the rubble and the entire site will be graded and seeded with 6 in. of soil.

The area under the loading dock suspected of containing pyrophoric uranium would need to be excavated as described in Alternative 2. Additionally, areas under the slab where the soil exceeds the radiological criteria would need to be solidified down to the depths indicated in Figure 1-20.

3.2.4.2 Radiological and Heavy Metal Materials (Alternative 4B)

This alternative is identical to Alternative 4A except that in addition to the radiological material, heavy metals will also be targeted for removal or in situ solidification. Soil exceeding 500 mg/kg for lead, 10,000 mg/kg for copper, 135 mg/kg for cadmium, or 160 mg/kg for thallium above the water table would be excavated and solidified below the water table. The estimated waste volume generated by this alternative is 25,540 m³ (33,400 yd³). An additional 22,170 m³ (29,000 yd³) would be solidified.



(FUS General) Process Model

Figure 3-1. Process Model for Alternative Development

**Table 3-1. Summary of the Evaluation for the Response Action Technologies
Screened for the Colonie Site**

Technology	Evaluation Result	Comments
No action	Retained	To be considered in accordance with CERCLA and NEPA.
Institutional controls Access restrictions Deed or use restrictions	Rejected as stand-alone but retained in combination	Would not in itself satisfy the primary objectives. Can be used in combination with other technologies.
Containment Surface barriers	Retained	Can limit COC mobility and can mitigate potential exposures. COCs do not appear to be migrating.
Subsurface barriers	Rejected	
Removal Excavation (soil)	Retained	Relatively straightforward to implement for soil; allows use of the remediated area without radiological restrictions. Requires storage or disposal facility and access restrictions during excavation, and requires consideration be given to address issues that may impact human health and the environment.
Pumping (Groundwater)	Rejected as stand-alone but retained in combination with excavation	Easy to implement but could potentially cause movement through the aquifer and further spread the COCs. Potential exists for movement of COCs offsite during extraction well construction.
Treatment (Soil)	Retained	Can reduce volume of residuals to be disposed or reduce mobility of constituents. Treatability tests would be required.
Treatment (Groundwater) Air Stripping, Carbon Adsorption, Ion Exchange, Sedimentation/Precipitation In-situ sparge/SVE	Retained	Applicable to treatment of groundwater for volatile organic compounds (PCE, TCE, and 1,2-DCE) and metals (lead, zinc, uranium, and thorium).
Waste Disposal Existing DOE Facility for low-level radioactive waste (LLRW) from Colonie site	Rejected	Implementable because capacity is available. Rejected because costs are high and transportation distance is greater.
Commercial disposal facility for LLRW, chemical and mixed waste from Colonie site	Retained	Implementable as capacity is available. Must comply with all regulations. Costs would be moderate to high.

Table 3-1. (continued)

Technology	Evaluation Result	Comments
Waste Disposal (continued): New onsite disposal facility for LLRW, chemical and mixed waste for the Colonie site	Rejected	Must comply with applicable regulations. Presence of radionuclides and chemical wastes could make siting a disposal area difficult. This option would have moderate to high cost. Rejected because of time constraints. Approval and construction of a new facility could take about 10 years.
Effluent Discharge/Disposal to Patroon Creek	Retained	These are potentially applicable to the Colonie Site. The effluent would have to be treated to meet the discharge criteria.